USAAEFA PROJECT NO. 82-06

AH-1 AIR GROUND ENGAGEMENT SIMULATION/AIR DEFENSE (AGES/ADES) POD JETTISON EVALUATION

FINAL REPORT

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SEPTEMBER 1982

UNITED STATES ARMY AVIATION ENGINEERING FLIGHT ACTIVITY
EDWARDS AIR FORCE BASE, CALIFORNIA 93534

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Coordinated Autorotation

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The AH-1 Air Ground Engagement Simulation/Air Defense (AGES/ADES) Pod Jettison Evaluation was conducted at Edwards Air Force Base, California (elevation 2302 feet). Six flights totaling 2.4 hours were flown from 31 August to 2 September 1982. Satisfactory jettison envelopes for the AGES/ADES pod were defined at a hover, in coordinated level flight to 130 KCAS, and in coordinated autorotation to 85 KCAS. One Equipment Performance Report was submitted pertaining to the difficulty of attaching the AGES/ADES pod to the aircraft.

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DEPARTMENT OF THE ARMY
HQ, US ARMY AVIATION RESEARCH AND DEVELOPMENT COMMAND
4300 GOODFELLOW BOULEVARD, ST. LOUIS, MO 63120

DRDAV-D

SUBJECT: Directorate for Development and Qualification Position on the Final Report of USAAEFA Project No. 82-06, AH-1 Air Ground Engagement Simulation/Air Defense (AGES/ADES) Pod Jettison Evaluation

SEE DISTRIBUTION

1. The purpose of this letter is to establish the Directorate for Development and Qualification position on the subject report. The report documents the results of the limited jettison tests of the AGES/ADES pod from the AH-1. The intent of the evaluation was to obtain flight test data necessary to substantiate a useable jettison envelope for the AGES/ADES pods in the event of emergency jettison requirements when the pods are used on training missions. Based on the test results, a satisfactory jettisoning envelope was demonstrated to 130 KCAS in coordinated level flight, in autorotational descents to 85 KCAS and in hover. When the pod is fielded it will be necessary to revise the Operator's Manual to reflect the jettison limitations or issue Airworthiness Releases for each AH-1 using the pod per the requirements of AR 70-62, Airworthiness Qualification of US Army Aircraft Systems, 15 July 1978, and to modify the installation instructions to include enlarging the bottom cut out on the access door to preclude the installation problem noted in this test report.

2. This Directorate agrees with the report conclusions and recommendations.

FOR THE COMMANDER:

CHARLES C. CRAWFORD, JR.
Director of Development
and Qualification

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INTRODUCTION

BACKGROUND

1. The United States Army Aviation Engineering Flight Activity (USAAEFA) conducted jettison testing of the production M-260, 7-round lightweight airborne launcher (LWL) during 1981 under USAAEFA Project No. 79-03 (ref 1, app A). A safe jettison envelope was defined at a hover, in level flight to maximum level flight airspeed (V_H) and in autorotation at the airspeed for maximum glide ($V_{maxglide}$). The Air Ground Engagement Simulation/Air Defense (AGES/ADES) weapons simulation pod was designed with a jettison capability (photo 5, app B). Although it has the same diameter as the M-260 LWL it contains additional electrical connectors which could cause aerodynamic changes during jettison (photo 6, app B). The United States Army Aviation Research and Development Command (AVRADCOM) requested that USAAEFA conduct an AH-1 AGES/ADES jettison evaluation (ref 2, app A).

TEST OBJECTIVE

2. The objective of this evaluation was to develop a safe jettisoning envelope for the AGES/ADES weapons simulation pod in hover and in level flight to 130 knots calibrated airspeed (KCAS) and in autorotative flight at $V_{maxglide}$ (85 KCAS).

DESCRIPTION

3. The test aircraft was an AH-1S (Prod) helicopter, USA S/N 76-22573 (photo 1). The AH-1S is a tandem seat, two place helicopter with a two-bladed main rotor, and a two-bladed model 212 tractor tail rotor. The helicopter is powered by a Lycoming T53-L-703 turboshaft engine derated from 1800 shaft horsepower (SHP) at sea level, standard day to 1290 SHP for 30 minutes at airspeeds below 100 knots indicated airspeed (KIAS) only, and 1134 SHP for continuous operation. The test aircraft was equipped with a nose-mounted instrumentation boom and a high-speed 16mm motion picture camera was mounted at fuselage station (FS) 65 on the right side of the helicopter (photo 1, app C). A detailed description of the helicopter is contained in the operator's manual (ref 3, app A) and brief description in appendix B. The AGES/ADES pod is a tactical simulation system that utilizes a coded laser beam to simulate various weapons systems. It provides visual and audible signatures for the various weapons of the Cobra. A detailed description of the AGES/ADES pod is contained in appendix B.

Photo 1. Right Side View

TEST SCOPE

4. The AH-1S AGES/ADES pod jettison evaluation was conducted at Edwards AFB, California. Six flights totaling 2.4 hours were flown from 31 August to 2 September 1982. Flight restrictions and operating limits were in accordance with the operator's manual (ref 3, app A) and the airworthiness release issued by AVRADCOM (ref 4, app A). The AGES/ADES pod jettison evaluation was conducted to establish a safe jettison envelope for the AGES/ADES weapons simulation pod. This test was conducted to determine compliance with AMCP 706-203 (ref 5, app A). Six jettisons were conducted, one statically, one at a two-foot hover, three in level flight (60, 100, and 130 KCAS), and one in autorotation at 85 KCAS, ($V_{maxglide}$). All jettisons were done in ball-centered, coordinated flight at an average gross weight of 8740 pounds, longitudinal cg at fuselage station (FS) 193.7 (Fwd), lateral center of gravity (cg) at Buttline (BL) 0.6 (right), average main rotor speed of 324 rpm, and at an altitude of 1000 feet above ground level (AGL).

TEST METHODOLOGY

5. Jettison tests were conducted by stabilizing the helicopter at the desired flight conditions and then jettisoning the AGES/ADES pod. The inflight jettisons were conducted over Rosamond Dry Lake at Edwards AFB. The jettison was recorded by a high-speed (400 frames per second) 16mm motion picture camera mounted on the test helicopter (photo 1, app C), in addition to a 16mm motion picture camera and a video tape camera onboard the chase aircraft. Flight test data were hand recorded from calibrated test instrumentation and from standard aircraft instruments. All jettisons were made from the right inboard store station. A detailed listing of the test instrumentation is contained in appendix C. Data analysis methods are described in appendix D.

RESULTS AND DISCUSSION

GENERAL

6. The AGES/ADES pod jettison evaluation was conducted to establish a safe jettison envelope for the AGES/ADES weapons simulation pod. During previous testing (ref 1, app A) a jettison envelope for the M-260 LWL was established at a hover, in level flight to V_H, and in autorotation at $V_{maxglide}$. During this test, the jettison characteristics of the AGES/ADES pod were found to be similar to those previously obtained for the M-260 LWL. The jettison characteristics did not appear to be significantly affected by the airspeed or rate of descent of the aircraft. In flight, the closest proximity of the AGES/ADES pod was 9.5 inches from the skid. Satisfactory jettison envelopes for the AGES/ADES pod were defined at a hover, in coordinated level flight to 130 KCAS, and in coordinated autorotational flight to 85 KCAS. Due to the limited scope of the test and number of pods available, jettisons were not made in maneuvering flight, or at sideslip conditions other than ball-centered, coordinated flight. One Equipment Performance Report (EPR) was submitted on the difficulty of attaching the AGES/ADES pod to the aircraft (app F). The AGES/ADES pod met the separation criteria of AMCP No. 706-203 (ref 5, app A).

JETTISON TESTS

Static Jettison

7. The static jettison test of the AGES/ADES pod was conducted with the helicopter on the ground and the engine and rotors static. The jettison was made on to a soft surface to reduce damage to the pod so it could be reused. A summary of AGES/ADES pod jettison characteristics is presented in table 1, appendix E. The minimum separation of the AGES/ADES pod and the helicopter skid was 8.9 inches.

Hover Jettison

8. The hover jettison test was conducted with the helicopter at a two-foot skid height. The helicopter was faced into steady winds of less than 10 knots. The jettison was made on to a soft surface to reduce damage to the pod so it could be reused. A summary of jettison characteristics is presented in table 1, appendix E. The separation of the AGES/ADES pod and the helicopter skid was 9.9 inches. The hover jettison characteristics of the AGES/ADES pod are satisfactory.

Level Flight Jettison

9. Three level flight jettisons of the AGES/ADES pods were made in coordinated level flight. The jettison characteristics are presented in table 1, appendix E. The results show that aircraft airspeed did not significantly influence jettison characteristics of separation distance, time to clear, jettison velocity, roll rate and direction, pitch direction, or direction of yaw. The AGES/ADES pod cleared the helicopter on all jettisons by at least 9.5 inches. There were no unusual aircraft motions during or following jettison. The jettison characteristics for the AGES/ADES pod are satisfactory in coordinated level flight to 130 KCAS.

Autorotational

10. An autorotational descent jettison was made at 85 KCAS ($V_{maxglide}$). The AGES/ADES pod did not contact the helicopter during this evaluation. The pod cleared the skid by 10.3 inches. There were no unusual aircraft motions during or following jettison. The jettison characteristics for the AGES/ADES pod are satisfactory in coordinated autorotational descent to $V_{maxglide}$.

CONCLUSIONS

11. The AGES/ADES weapons simulation pods are compatible with the AH-1S (Prod) helicopter and can be jettisoned safely, at a hover, in coordinated level flight up to 130 KCAS, and in coordinated autorotation to $V_{maxglide}$ (para 7-10).

12. One EPR was submitted (para 6) (app F).

RECOMMENDATIONS

13. The jettison envelope for the AGES/ADES weapons simulation pod should be limited to a hover, to coordinated level flight to 130 KCAS, and to coordinated autorotational descent to an airspeed of 85 KCAS, $V_{maxglide}$ (para 11).

14. In the event of any further jettison testing on the AGES/ADES pod, a limited evaluation on the effect of sideslip and maneuvering flight should be conducted.

APPENDIX A. REFERENCES

1. Final Report, USAAEFA Project No. 79-03, *AH-1 Lightweight Airborne Launcher Jettison Evaluation,* April 1981.

2. Letter, AVRADCOM, DRDAV-DI, 2 July 1982, subject: AH-1 Air Ground Engagement Simulation/Air Defense (AGES/ADES) Pod Jettison Evaluation. (Test Request)

3. Technical Manual, TM 55-1520-236-10, Operator's Manual, *Army Model AH-1S, AH-1S (ECAS), AH-1S (Modernized Cobra) Helicopters,* 11 January 1980.

4. Letter, AVRADCOM, DRDAV-DI, 27 August 1982, subject: Experimental Airworthiness Release for AH-1S Jettison Evaluation of the Air-to-Ground Engagement Simulation/Air Defense Engagement Simulation (AGES/ADES) Pod, (USA)AEFA Project No. 82-06.

5. Army Material Command Pamphlet, AMC Pamphlet No. 706-203, *Engineering Design Handbook Helicopter Engineering, Part Three, Qualification Assurance,* 3 April 1972.

APPENDIX B. DESCRIPTION

TEST HELICOPTER DESCRIPTION

1. The test aircraft, USA S/N 76-22573, an AH-1S (Prod) helicopter, was manufactured by Bell Helicopter Textron. A detailed description of the standard AH-1S (Prod) helicopter may be found in the operator's manual. Special equipment installed on the airframe to assist in the jettison test was an external camera pedestal used to secure an electrically operated high speed 16mm motion picture camera. The pedestal was fabricated by the US Army Aviation Engineering Flight Activity (USAAEFA) and was mounted on the right side of the helicopter at fuselage station (FS) 65 (photo 1, app C).

AIR GROUND ENGAGEMENT SIMULATION/AIR DEFENSE POD DESCRIPTION

2. The AGES/ADES pod utilizes a coded laser beam to simulate various weapon systems during simulated tactical engagements. It provides visual and audible signatures for the various weapons of the Cobra. The pod itself has the same diameter as the 7-round rocket launcher.

3. The AGES/ADES pod (photo 6) consists of a metal cylinder, strong back, attaching hardware and various internal electrical components. It is basically a hollow cylinder 10.25 inches in diameter and 47.5 inches in length to which the electrical components are mounted. The average weight is 94 pounds.

Photo 1. Front View

Photo 2. Right Front Quartering View

Photo 3, Right-rear Quartering View

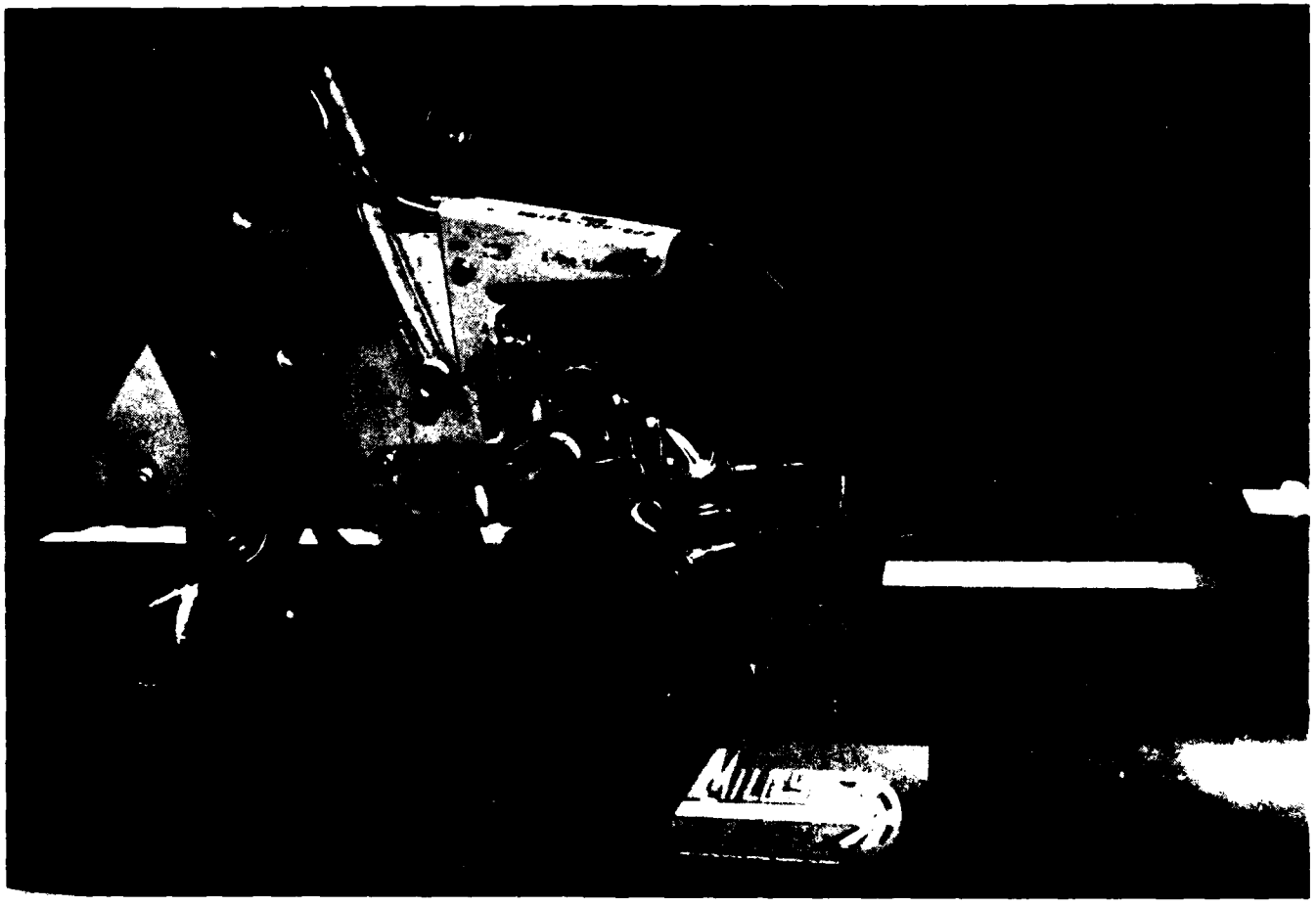

Photo 4. Attached Electrical Components

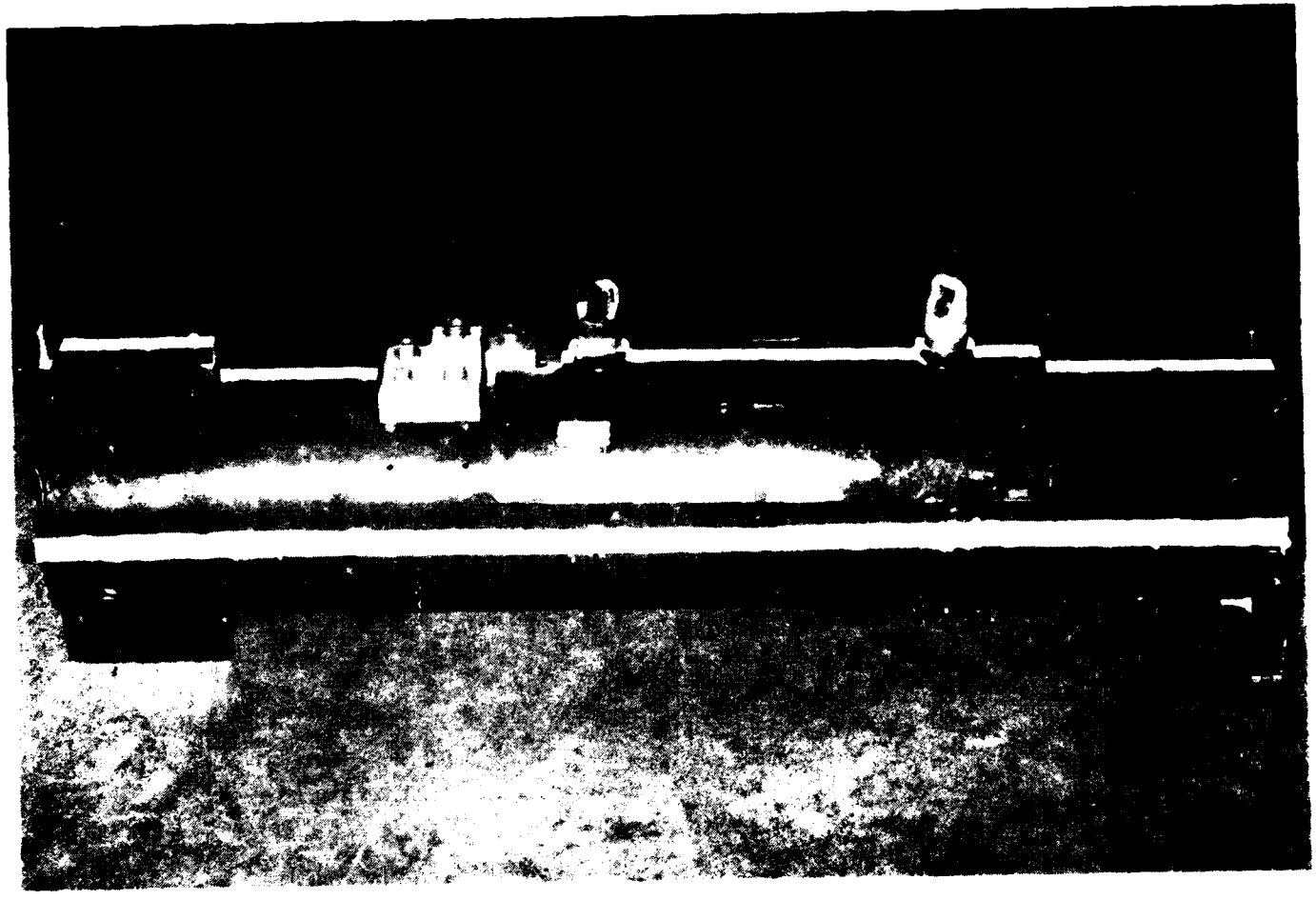

Photo 5. Left side View

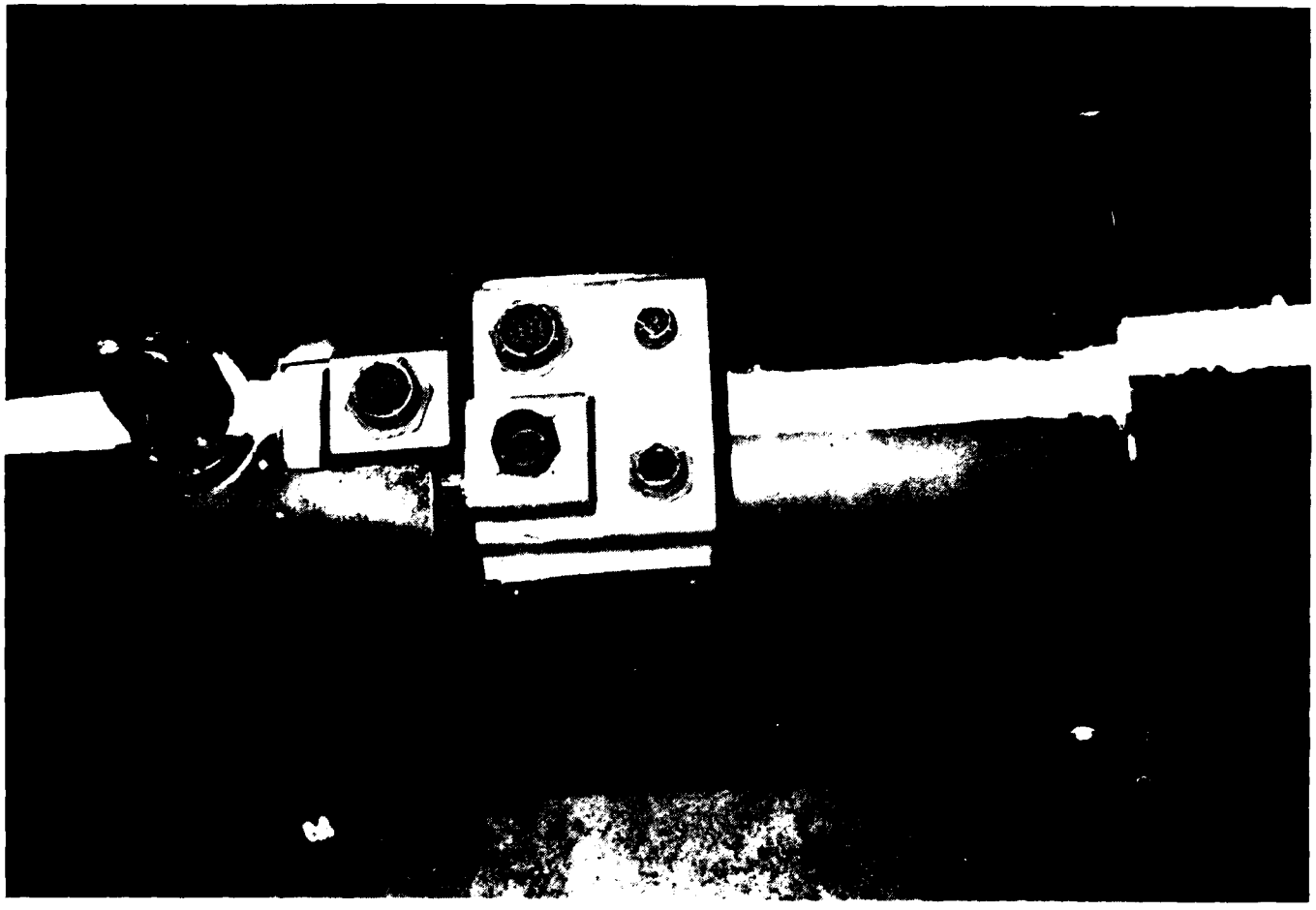

Photo 6. Top View

APPENDIX C. INSTRUMENTATION

1. The test aircraft had a boom installed extending forward from the nose incorporating a swiveling pitot-static source and sideslip vane. The boom system had airspeed, altimeter, and sideslip indicators connected to sensitive cockpit instruments. A test fuel used totalizer was installed. All other cockpit instruments were standard. Calibration of the test indicators was accomplished by USAAEFA personnel.

2. The following parameters were displayed:

Pilot Panel

Airspeed (boom)
Altitude (boom)
Free air temperature (ship)
Rotor speed (ship)
Fuel quantity (ship)
Sideslip angle (boom)
Instrument panel lateral acceleration (turn and slip indicator)
Rate of climb (ship)

Copilot Panel

Airspeed (boom)
Altitude (boom)
Rotor speed (ship)
Rate of climb (ship)
Time (ship)
Observed air temperature
Fuel used

3. A high-speed 16mm motion picture camera was used for recording jettison data. The camera was mounted on the test helicopter at FS 65 with the actuation switch located at the copilot's station (photo 1).

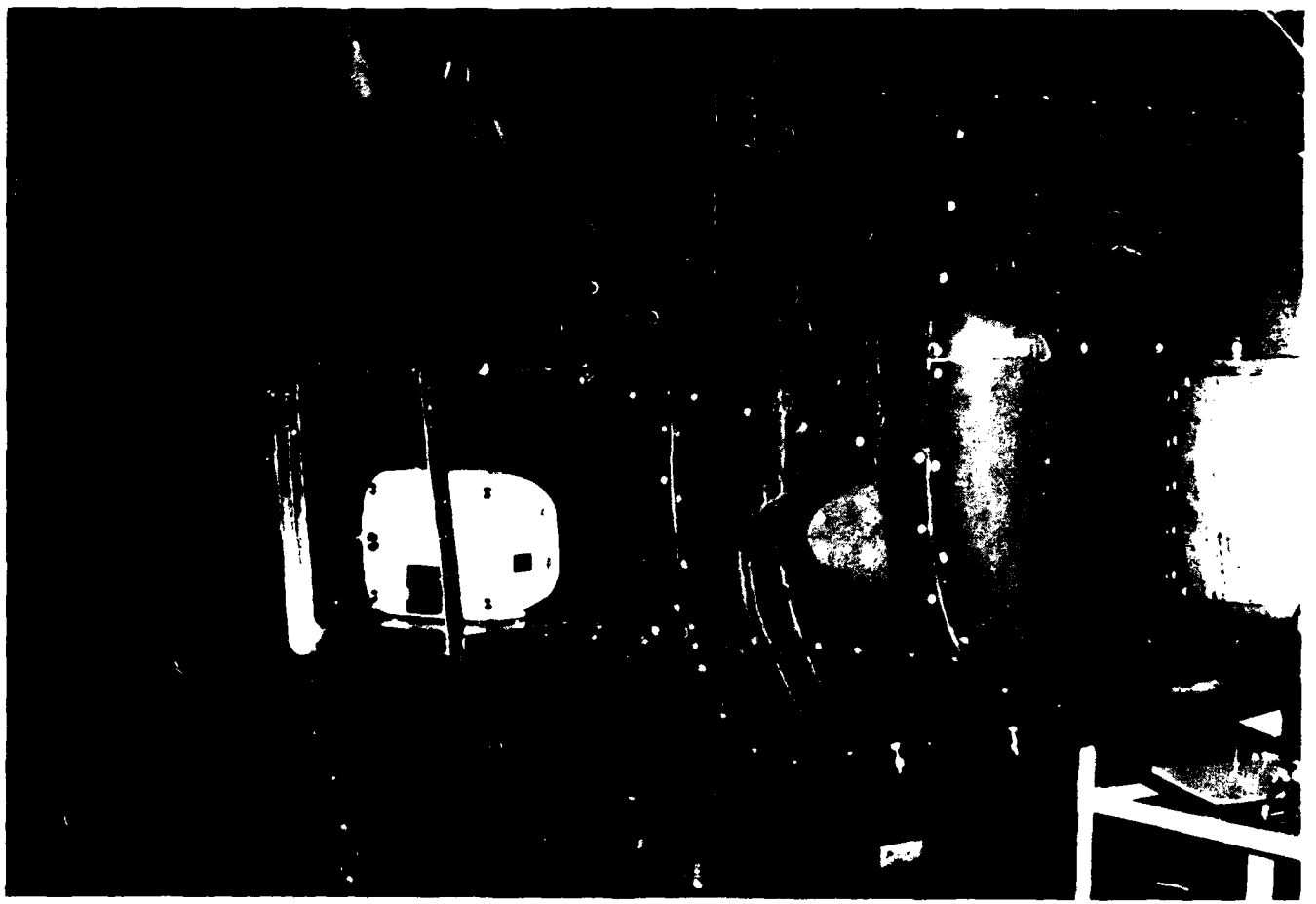

Photo 1. High Speed Camera and Mount

APPENDIX D. DATA ANALYSIS METHODS

1. The analysis of the 16mm motion picture taken during the evaluation provided the jettison characterisics of: clearance between the AGES/ADES pod and helicopter, jettison velocity, and pitch, direction, and roll velocities. A photo analyzer capable of displaying a single frame of film at a time was used for data reduction.

2. The procedure used to compute the linear and angular velocities was to compare measurements taken from 16mm frames of film 0.025 second apart based on a standard film speed of 400 frames per second. These velocities were determined by measuring the trajectory 0.05 second after the AGES/ADES pod separated from the ejector piston pad. An attempt was made to correct all measurements due to change in AGES/ADES pod image size as distance from the camera varied.

APPENDIX E. TEST DATA[1]

Table 1. AGES/ADES Pod Jettison Characteristics[2]

Flight Condition	KCAS[3]	Yaw Direction	Pitch Direction	Roll Direction and Rate[4] (deg/sec)		Avg Jettison Rate[5] (ft/sec)	Minimum Clearance (in.)	Time to Clear (sec)
Static	-	Left	UP	Left	60	28.9	8.9	0.9
Hover	0	Left	UP	Left	60	21.9	9.9	0.12
Level	60	Left	UP	Left	70	23.8	9.5	0.11
Level	100	Left	UP	Left	60	22.0	10.3	0.12
Level	130	Left	UP	Left	70	20.2	9.8	0.13
Autorotation	85	Left	UP	Left	50	19.6	10.3	0.13

NOTES:

[1]AH-1S (Prod) at average G.W. 8740 lb, Average Longitudinal cg 193.7 (Fwd), Lateral cg at BL 0.6
Main Rotor speed: 324 rpm. Coordinated flight (ball-centered)
All jettisons from right inboard store location, all other stations clean
[2]AGES/ADES: Air Ground Engagement Simulation/Air Defense
[3]KCAS: Knots calibrated airspeed
[4]Rate measured 0.05 seconds after separation from ejector piston pad
[5]Rate measured as average velocity from jettison to skid clearance

APPENDIX F. EQUIPMENT PERFORMANCE REPORT

EQUIPMENT PERFORMANCE REPORT

(DARCOM AMCR 700-38)

DATE: 2 Sep 82

OFFICE SYMBOL: DAVTE-TA

Commander
US Army Avn Res & Develop Cmd
ATTN: DRDAV-D
4300 Goodfellow Blvd
St. Louis, MO 63120

FROM: Commander
US Army Avn Engr Flt Activity
ATTN: DAVTE-TA
Edwards AFB, CA 93523

1. EPR NO.	2. TLCOM/AVSCOM PROJ NO.:	3. TEST TITLE
82-06-1	82-06	AGES/ADES POD AH-1S Jettison Test

I MAJOR ITEM DATA

4. MODEL: AH-1S (PROD)	5. SERIAL NO. 76-22573
6. QUANTITY	7. LIFE PERIOD:
8. MFR: Bell Helicopter Textron	9. USA NO.:

II PART DATA

10. NOMENCLATURE/DESCRIPTION: Fair Assy Pylon RH

11. FSN: 1560 00 136 2384	12. MFR PART NO.: 209-071-038-48
13. DRAWING NO. FIC33, Items, CS 169	14. MFR: U
15. QUANTITY: 1	16. NEXT ASSEMBLY: U
17. MAC FUNCTIONAL GRP:—	18. PART TEST LIFE: U

III INCIDENT DATA

19. DATE OF OCCURRENCE:		20. TYPE OF REPORT:		21. ACTION TAKEN:	
MAINT SPT. ELM. CODE:			a. INCIDENT		a. REPLACED
OBSERVED DURING	24. TEST ENVIRONMENT:	X	b. INFORMATION		b. REPAIRED
a. OPERATION	Daily	25. INCIDENT CLASSIFICATION:		X	c. ADJUSTED
X b. MAINTENANCE			a. CRITICAL		d. DISCONNECTED
c. INSPECTION			b. MAJOR		e. REMOVED
d. OTHER			c. MINOR		f. NONE

IV INCIDENT DESCRIPTION

22. DESCRIBE INCIDENT FULLY (INCLUDE IMPACT OF INCIDENT ON MAC CODE IDENTIFIED IN BLOCK 22):

When mounting AGES/ADES weapons simulation pod on inboard right hand wing store station, the additional electrical wiring due to additional cannon plugs on the AGES/ADES pod, made it impossible to shut the access door on the fairing attached to the ejector rack. Enlarging the bottom cut out on the access door solved the problem.

INCIDENT CLASSIFICATION IS SUBJECT TO RECLASSIFICATION.

27. DEFECTIVE MATERIAL SENT TO:

28. NAME, TITLE & TEL EXT OF PREPARER:	29. FOR THE COMMANDER:
RICHARD T. SAVAGE CPT, AR, DAVTE-TA Project Officer, USAAEFA 82-06-1 AV: 350-4935	JOHN O. BENSON MAJ, US ARMY Ch, Plans and Programs

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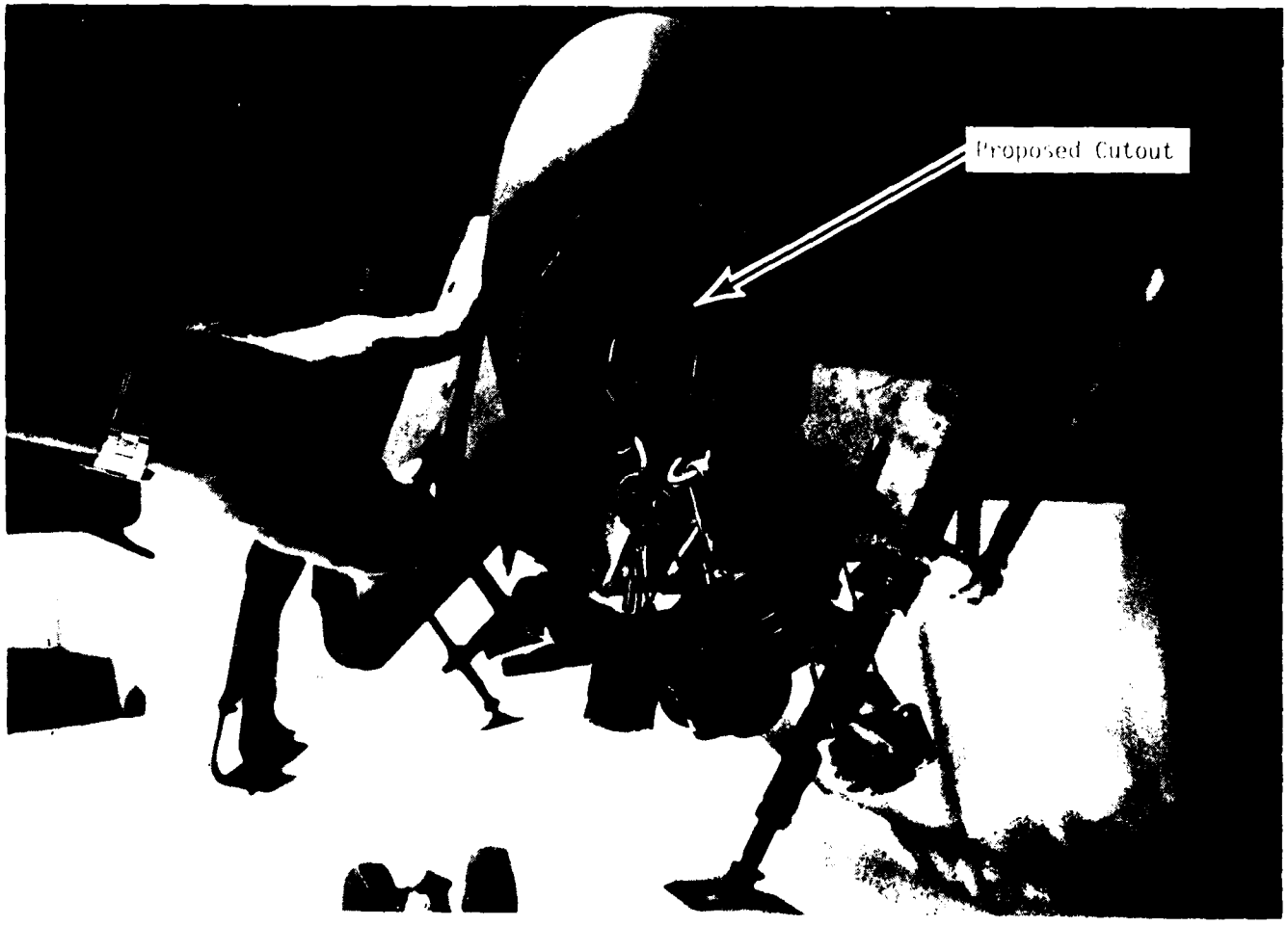

Photo 1. Proposed Modification to Door

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MTMC-TEA (MTT-TRC)	1
ASD/AFXT	1
Project Manager, Training Devices (DRCPM-TND-GE)	5
Naval Training Equipment Center (Code N234)	3
Project Manager, Cobra (DRCPM-CO-T)	3